COMMON INSECTS,
AS SEEN THROUGH THE MICROSCOPE.

WRITTEN TO ACCOMPANY A SERIES OF THIRTY-SEVEN PHOTO-MICROGRAPHIC LANTERN SLIDES, PUBLISHED BY

NEWTON & Co., 3, FLEET STREET, LONDON.

(*Slide a.*) *Introduction.*

Common insects are so little understood by the majority of persons that it was thought a slight sketch of some of their forms, habits, and the various changes they pass through would not be altogether without interest.

We need not dip very deeply into the science of Entomology to find much that is entertaining as well as instructive, and I would draw your especial attention to the fact that the slides we shall see to-night are not drawings or sketches more or less inaccurate, but photographs of the actual objects themselves, as we see them through the microscope.

1.—*Frog Hopper or Cuckoo-Spit.*

We will commence with a class of insects unfortunately so common as to claim paramount attention when "common" insects are under consideration. I mean that numerous class, which, living on the vital juices of plants, causes what is known as blight. These creatures are so numerous that we can only take one or two examples. The specimen now shown is the Frog Hopper, in its perfect state. Like all other insects, this one passes through the various stages of the egg, the larva, the pupa, and the perfect insect, which, in the autumn, lays the eggs, from which, during the following summer, the larvæ will emerge. As soon as it is hatched, the larva pierces the bark of the plant to which the egg was attached, and sucks the sap of the plant so greedily that it oozes out of its body continually in the form of little bubbles, which soon completely develop the insect, and from this peculiarity it derives its name of Cuckoo-Spit. If you take the trouble to examine one of these objectionable-looking masses of sap bubbles, you will invariably find one or more of these little creatures still greedily imbibing sap. In this concealment the larva remains till the final change takes place, being, during the pupal stage, of a bright green colour, which, however, changes to a brown when the perfect insect emerges. The Frog Hopper takes its name from the astonishing leaps it is able to make, leaps in which it is greatly assisted by a peculiar growth of spines on the lower leg joints. It is a little brown insect with a flat head, and hard wing-cases, and is often seen motionless on a plant, and apparently asleep, but on touching its back lightly with the finger, it gives a vigorous spring, moving so quickly through the air that it is impossible for the eyes to follow it.

2.—*The Aphis.*

Another even worse blight insect is the Aphis, one species of which is so often found on our rose-trees. This peculiar little fellow, like the Frog Hopper, pierces through the bark and feeds on the juices of plants. The Aphides multiply so fast, that were it not for their numerous enemies and inclement weather, they would utterly destroy the various species of plants on which they live. So astonishing is their power of reproduction, that from a single aphis, were there no such checks upon their numbers, ten thousand million millions might be produced in the short space of three months. Most of these Aphides are of a bright green colour, and some have gauzy wings, while others are entirely wingless. Their principal enemies are Ladybirds, and the larvæ of several insects, which feed upon them, and destroy vast numbers; and if from any cause the Ladybirds are a few days late in their arrival, the Aphides multiply so fast as to do serious damage to crops, before their enemies put in an appearance. The Aphis being an insatiable feeder, and having no digestive organs, the surplus sap which it imbibes, exudes from two small tubes, which may be clearly seen projecting from the body for that purpose; and it is this *honey-dew*, as it is called, that makes the leaves of rose-trees so sticky when suffering from this form of blight. The honey-dew is very sweet, and is much enjoyed by ants; and this leads to a very curious arrangement. Some species of ants kidnap as many of the Aphides as they require, and carry them off underground to their own cities, and there keep them in a sort of stables, feeding them on their favourite foods, and milking them, if we may call it so, at proper intervals, much as we ourselves treat cows.

3.—*Ladybird Larva.*

We will next glance at one of the principal enemies of the Aphis,—and, consequently, one of the best friends of agriculturists and gardeners—I mean the Ladybird, or *Coccinella septempunctata*, which is the correct title of the common seven-spotted ladybird, which we see in such numbers in our gardens.

4149

The larvæ of these insects, one of which is now on the screen, are blackish creatures, with red and yellow spots; and like the perfect insects, live entirely on the Aphides or plant-lice. When they have completed their first stage of life—the larval form—they enter on the pupal stage by becoming black-looking chrysalides, which give birth to their beautiful inmates in the months of May and June.

4.—*Ladybird.*

The form of the common ladybird, with its rounded elytra, or wing-cases, of bright red with black spots, is so well known that it is unnecessary to describe it now. The form of the other various species is similar, but the colouring varies—one of the most beautiful being yellow with black spots.

On the screen is shown one of these ladybirds with the elytra opened, showing the flying wings beneath, for these insects have considerable powers of flight. There are some ladybirds of very small size, and blackish colour, usually with a yellow spot at the end of the wing covers, whose larvæ are clothed with short tufts or flakes of the most delicate white down. These insects belong to the genus Scymus, which means a lion's whelp, and they well merit such a name; for the young, in proportion to their size, are as sanguinary and ferocious as the most savage beasts of prey. One of these little tuffed animals may occasionally be seen preying upon the plant-lice, catching and devouring with the greatest ease individuals nearly as large as its own body, one after another in rapid succession, without apparently satisfying its hunger, or diminishing its activity.

The larvæ are hatched from little yellow eggs, laid by the parent insect in clusters, among the plant-lice, so that on emerging they find themselves at once within reach of their prey, which from their superior strength they are enabled to seize and slaughter in great numbers.

5.—*(Indian) Tortoise Beetle.*

Another insect, found in close contiguity with the ladybird in our gardens, is the tortoise beetle. It is usually on mint and other plants of the same sort that we find its singularly formed larva, which is yellowish brown in colour, of an oval shape, and has the sides of the body edged with a fringe of projecting fibres; the two terminal ones are longer than the rest, and generally carried over the body towards the head, when the animal is in motion. On these filaments the animal collects matter, and forms a canopy over its back, apparently for the purpose of defending itself from the attacks of its enemies. When it arrives at maturity it fastens itself to a leaf, casts its skin, and commences the pupa state; the pupa is of a peculiar shape, very broad in the forepart. In three weeks the complete insect emerges, when its length is nearly a quarter of an inch, its body of an oval shape, and its colour bright green above, with the underpart black.

The specimen on the screen is an Indian variety of the tortoise beetle, which has been selected instead of an English one, in order to show the curious form of the wing-cases. The wings themselves of the usual gauzy texture are seen extended as during flight, but when not in use are folded under and protected by the horny wing-cases.

6.—*English Wood Ant.*

The specimen now shown is one of the "Hercules" ants, which are so common in our English woods.

There are so many species of ants, both English and foreign, that we cannot go into all their peculiarities to-night, but will confine ourselves to the principal points in their form and life history. Their general appearance is well known. The eyes are black, and under them are two small horns, or feelers, composed of twelve joints, all covered with fine silky hair. The mouth is composed of two crooked jaws, which project, and in each of which appear incisures, resembling teeth. Ants have six legs, the extremities of each being armed with two small claws, which assist the insect in climbing.

The body is of a brown chestnut colour, shining like glass, and covered with fine hair. The males have always four wings; the females are larger than the males, and only possess wings during the pairing season; but the neuters have none at any period. If an anthill be examined any time after midsummer, up to the close of autumn, there may be seen, mixed with the wingless workers, a number of both males and females, with white glistening wings. These males and females are fed and tended entirely by the workers, being, however, virtually their prisoners, kept under close watch and ward, and hauled back by legs and wings if they stray away. There seems to be a uniform disposition in the winged ones to desert their colony. When the pairing season arrives they take to flight; and as they never return of their own accord, the females are searched for, and some are carried back by the workers. The males probably die, as the workers never bring them back, and they are entirely defenceless, and destitute of mandibles to provide for their own subsistence. In thus leaving the nest, they seem to use their wings for the first and last time. Each female, immediately on alighting, examines the situation in which chance has placed her, and if she finds it adapted to her purpose, she turns her head back on her shoulders, and with her sharp mandibles tears off the wings which bore her from the place of her nativity.

Strange as this may seem, it is the result of unerring instinct, for henceforth her wings would prove more of a hindrance than a help.

If she does not happen to be recaptured, she sets to work to make a nest, lay her eggs, and form a new colony on her own account, and by her own unaided efforts showing that she *can* work if she likes, but if there is anyone else to do it for her, she never does like.

After the eggs are laid they gradually increase in size, and become so transparent, that the enclosed insect may be seen. When the eggs are hatched, the young grubs are fed either by the mother, when she is alone, or by the workers, with a liquid disgorged from the stomach.

When the larvæ have attained their full growth, they spin a silken cocoon; in this they enclose themselves, and remain perfectly motionless, and without receiving nutriment, awaiting the final change. This stage is the pupa, which is constantly mistaken for the egg. The cocoon is of a cylindrical form, dirty white in colour, and quite motionless.

Before the insect emerges it is distinctly visible; but the limbs want strength and consistence, and are covered by a skin which has yet to be cast. In colour the creature changes from white to a pale yellow, then to red, and finally becomes almost black; its wings, if a male or female, are there, but do not assume the proportion which they are afterwards destined to obtain. When the insect first leaves the cocoon, it is under the careful and devoted guardianship of the workers; it is attended in all its wanderings about the nest, and made acquainted with its galleries and chambers; the wings of the males and females, previously folded together, are extended for them; and this is done so carefully that the delicate members are never injured in the operation; in fine, these founders of future colonies are in all respects served with unremitting attention by their servants, the working ants, who not only sustain the idlers at home, but provide their own food, and occasionally fight neighbouring colonies who are inclined to trespass.

They feed on a variety of things, killing and devouring weaker insects, as well as seeking ripe fruits, and whatever appears to contain saccharine matter, of which they are very fond, hence their liking for the honey-dew of the Aphis, already mentioned.

7.—*Ant-lion.*

One of the most formidable enemies of the ants is the Ant-lion *(Myrmeleon formicarius)*, which lives almost entirely on these insects. In appearance it looks about as unfitted for catching such active nutriment as it could possibly be. Its body is large and awkward in the extreme, particularly when the size of its legs, and their want of muscular power, are taken into account. It can walk but slowly, and only in a backward direction, so that its chance of living to a ripe old age, and eventually turning into a sort of dragon-fly, which is its natural destiny, seems rather remote.

But so far as it depends on catching ants to feed upon, what is wanting in activity, is more than made up in intelligence.

The Ant-lion, knowing its own deficiencies in activity, forms a trap or pitfall to enable it to catch its prey; and accomplishes it in this manner.

Selecting a light, sandy soil, it walks backwards in a circle, about three inches in diameter, with its tail depressed, so as to make a circular line on the ground. Having thus marked the limits of its pit it proceeds to scoop out the interior. Getting within the circle, and using one of its legs as a shovel, it places therewith a load of sand on the flat part of its head, and throws the whole with a jerk some inches beyond the circle.

It is worthy of remark that it only uses one leg in this operation, the one, namely, which is nearest the centre of the circle. Were it to employ the other in digging away the sand, it would encroach upon the regularity of its plan. Working with great industry and adroitness in the manner just described, it quickly makes the round of its circle, and as it works backwards, it soon arrives at the point where it had commenced. Instead, however, of proceeding from this point in the same direction as before, it wheels about and works around in the contrary direction; and in this way it avoids throwing all the fatigue of the labour on one leg, alternating them every round of the circle.

The pitfall, when finished, is usually about three inches in diameter at the top and about two inches deep, gradually coming down to a point, like a funnel. In the sand at the bottom the insect buries itself, leaving only its jaws exposed, and waits for its dinner, which will presently come in the form of some inquisitive ant, very anxious to investigate the little mound of sand with the depression in the middle of it, and apparently all the more anxious to do so, because it is no business whatever of his. Once on the verge of the hole, the sand so loosely thrown up gives way beneath the weight of the ant's body, and down he slides, with a small avalanche of sand, into the jaws of his enemy. Should he succeed, when sliding down the sloping sides of the pit, in gaining a foothold, and endeavour to regain the top, the Ant-lion once more loads his head with sand, and throws it at the retreating ant, almost invariably bringing him back into the pit.

The Ant-lion having, like many other insects, no mouth, merely sucks the juices of its victims through the tubes which run longitudinally through its jaws, and then, with a jerk of its head, throws the dry carcase some distance outside the trap.

Having repaired any damage that may have been done to the pitfall, the insect again buries itself in the sand at the bottom, and waits patiently for fresh victims.

8.—*Trachea of Silkworm.*

The breathing arrangements of all true insects are so different to our own, that it will be well to glance at them before going further.

We will take the silkworm as a typical specimen of the system; and we find that instead of the blood being oxygenated or aerated at one centre, and thence being distributed through the body, as is the case with ourselves, the silkworm is provided with two long tubes, passing down the entire length of the body, and branching out at intervals into clusters of smaller tubes, which, in their turn, convey the air received by them from the main tubes into the remotest parts of the body, thus reoxygenating the blood locally in every part.

This arrangement of tubes is called the Tracheal system, and is common, with slight variations, to all insects.

9.—*Tracheal Tube.*

(*More highly magnified.*)

It is obvious that the movements of the body might partially close these tubes, or fold them so tightly that the air could not pass, and provision is accordingly made to prevent the insect choking itself in this uncomfortable manner, by a spiral arrangement similar in appearance to a coiled wire spring inside the tubes, which, forming a cylindrical pipe, keeps the tube distended, thus answering the same purpose as the coiled wire in common use in india-rubber gas tubing. The coiled spring also interferes much less with the natural movement of the insect's body than any rigid substance would do, adapting itself to the elongating and shortening of the body, which takes place when the silkworm walks.

10.—*Spiracle of Dytiscus.*

The air is admitted into these tubes by a series of holes—about ten in number—in the sides of the insect, and not through the head, as in our own case.

Of course, any small pieces of dirt or other matter entering the tubes might cause serious consequences to the insect, and therefore these apertures are furnished with a screen of hairs, so disposed as to filter the air before it enters the Tracheal system, and prevent foreign substances from passing. These breathing holes are called "spiracles," and though they vary considerably in different insects, their general appearance may be seen from the one now shown on the screen, which is a spiracle of the Dytiscus Beetle.

11.—*Gizzard of Cricket.*

Some insects, as we have already seen, are entirely destitute of digestive organs; but others are exceedingly well furnished in this respect. The cricket, for instance, has not only a very powerful pair of jaws, but also a gizzard, a photograph of which we have now before us. The gizzard in our specimen is laid open, to show the tooth-like formation of the grinders through which the food passes.

12.—*Spider.*

Strictly speaking, the next object which we show has no claim to be considered to-night at all, for a spider is not an insect, being debarred that privilege for several weighty reasons, one of the principal being that it does not breathe through spiracles, as we have just seen all properly brought-up insects should do, but by leaf-shaped gills in connection with its heart.

Besides this, spiders have eight legs, whereas insects have only six; and they also have eight fixed eyes. But they are nearly enough akin to insects for our purpose this evening. The head and shoulders of the spider are all in one, without any division between them, as may be seen on the screen; and the front portion of the head is furnished with a pair of powerful mandibles, strongly jointed. When a fly is caught, the mandibles are thrust into its body, and the spider has the power of passing a drop of poison down the manibles into its victim.

The large, plump, beautifully marked spiders we see in our gardens in summer and autumn are all females, they having summarily disposed of their lords and masters in the earlier part of the year, by the simple and effectual method of killing and eating them.

The species of spiders are almost endless. There are the ordinary garden spiders of several species, which build the geometrical webs; the labyrinthic spiders (*Agelana labyrinthica*), which construct the broad, flat webs which we see spread out in a sloping position in hedges and low bushes; and the hunting spiders, which obtain their prey without the assistance of these traps. Beyond the numerous species in these classes are many others, such as the water spiders, of which we have no time to speak to-night.

The largest of the hunting spiders has a body as large as a pigeon's egg, and its legs are so covered with hair as to resemble fur. This species preys chiefly on small birds.

13.—*Spinnerets of Spider.*

Spiders are furnished with a web-spinning arrangment peculiar to themselves, consisting of four spinnerets, as they are called, each spinneret being punctured at the end in several places; and from each of these punctures the spider emits a small quantity of glutinous matter, which is drawn out in a fine thread, and combined by the aid of the hind legs with similar threads from the other punctures to form a silk cord, which we know as spider's web.

When attaching a thread to any object, the spider touches the spinneret lightly against it, the glutinous matter exuding from each puncture, thus becoming attached to the object at as many points as there are punctures, and as the spider moves away each is drawn out into a fine thread, and all are twisted together while still sticky into a strong cable, each separate strand of which is securely attached to the object. This gives wonderful strength to the whole, and resembles our own method of making strong cables, it being well known that a cable made of small strands twisted together is stronger than if made in any other way.

14.—*Foot of Spider.*

The foot of a spider possesses one or two special points, which are well worth studying. It consists of three claws or hooks of varying sizes, very horny and powerful, and so joined on to the leg as to give great mobility. From the under edge of each claw hangs a series of teeth like those of a comb, and with this comb the spider cleans his web. This comb-like structure also helps to grip the web tightly when the claws are closed over it.

15.—*The House Fly.*

The transition from a spider to a fly seems so natural as not to require any apology.

Flies are so numerous that we must confine our attention to one specimen ; and in order to keep strictly to the title of our lecture—"*Common Insects*"—that specimen will be the common house fly, *Musca Domestica.*

These flies are hatched from eggs laid the previous year, as soon as the weather becomes sufficiently warm. The eggs are deposited by the mother insect, by means of the long tube shown on the screen—called the ovipositor—in the safest accessible place to await the hatching.

The larva is an elongated maggot with a small head, and a pair of spiracles at the tail, through which it breathes.

The fly's proboscis is seen extended as it appears when the insect is eating ; but we need not take note of its details now, as we shall presently see it again under higher magnification. There is, perhaps, no common insect about which so little is known as the fly, but still, as we shall see, the microscope reveals some most interesting facts when we come carefully to examine it. These insects are of great service in the economy of nature, their province being the consumption of decaying animal matter, which is found about in quantities so small as to be imperceptible to most people, and is not removable by ordinary means even in the best kept apartments during hot weather. Although to an ordinary observer it would seem impossible that any really large quantity of matter could be disposed of by such means, it was asserted by Linnæus that three flies would consume a dead horse as quickly as a lion would. This was, of course, said with reference to the offspring of such three flies, and it is possible that the assertion may be correct, since the young begin to eat as soon as they are born. A single blow-fly has been known to produce 20,000 living maggots, and each of these continues to eat so voraciously that in 24 hours it has increased its own weight 200 times; in five days it attains to its full size.

When the maggots are fullgrown they change into the pupa state, and remain in it a few days; they then become flies, and within 14 days of emerging from the egg, they themselves produce thousands more maggots, which in their turn become flies, and this goes on until the whole brood is destroyed by winter's cold.

16.—*Foot of Fly.*

Examining the foot of a fly under a higher magnifying power, we find that it is furnished with a pair of horny hooks, or claws, and with two pads; it is these pads which enable the insect to walk up a pane of glass, or along a ceiling. The pads are covered with fine hairs, which are tubular, and from which exudes an exceedingly minute quantity of glutinous matter, sufficient, probably with the aid of some slight sucking action, to support the light weight of the insect. The "footprints" thus left by flies on glass are distinctly visible by aid of the microscope.

This photograph is not taken from the foot of the common house fly, but from another species; the feet, however, are so much alike that this is of no consequence for our purpose.

17.—*Eye of Fly.*

The network now shown is the cornea of a fly's eye. On looking carefully at the head of an ordinary house fly, protuberances will be noticed, one on each side of the head. These are covered with a fine network, only discernible by the microscope; and each hexagon in this network forms the slightly horny case of an eye. As these eyes are immovable, it is necessary for the insect to have some pointing in each direction; and this is accomplished by means of the network being stretched over the two hemispherical protuberances on the head. Some of the eyes, therefore, look out behind; while others are keeping watch above, below, before, and around. Hence it is just as difficult to approach a fly from behind as in front, a fact which can easily be tested by trying to approach the finger from behind, close enough to touch a fly without causing it to fly away. The ordinary house fly has no fewer than 7,000 of these eyes.

18.—*Head of Crane Fly.*

In the head of the crane fly, now shown, the eyes are seen *in situ*, and it will be noticed what an important and prominent position they occupy.

19.—*Proboscis of Fly.*

The proboscis of a fly is a most wonderful and beautiful structure; it constitutes the insect's only mode of feeding, the fly being entirely destitute of teeth or grinders of any sort, unless indeed a peculiar formation at the base of the tubes may have some similar functions, as appears possible. The pair of palpi, or feelers, seen on the right and left of the central tube are covered with tiny hairs. The proboscis, or trunk, forms a sucking apparatus, which seems perfectly adapted for feeding on liquid food, but which appears quite inadequate, being soft and fleshy, to the consumption of the particles of a solid lump of sugar, for instance, and yet we often find flies feeding on such articles, and apparently making a very good meal too. The microscope again comes to our assistance; by its aid we see that the insect first passes down the tube a small quantity of liquid, and then reversing the process, sucks it again up the same tube, charged with the dissolved sugar.

20.—*Part of Proboscis of Fly.*

(More highly magnified.)

The upper portion of the proboscis is shown spread out as in use, and shows the tubes stretching to right and left; but when at rest, this is all folded up, and withdrawn into a deep fissure on the under-surface of the head.

We now still further magnify a small portion of this tip of the tongue, and we see the beautiful spiral formation of the small tubes, which by its appearance will remind you of the spiral breathing tubes, or trachea, which we were looking at earlier in the evening. This formation helps to make the tip of the proboscis very flexible and mobile.

21.—*Saws of Saw-fly.*

When examining the house fly just now, we noticed the ovipositor, or organ by means of which the insect deposits its eggs in the most suitable places to await hatching. In some insects this organ is very peculiar, and well worth notice.

The ovipositor of the saw-fly, for instance, is admirably adapted for its purpose. This fly lays its eggs along the projecting veins on the underside of the leaves of the gooseberry-bush; the eggs being so firmly attached that they cannot be removed without crushing them. The instrument used for cutting the leaf is the most remarkable piece of perfect mechanism possible; and is securely lodged, when not in use, in a long narrow slit, on the underside of the body. It consists of four horny portions, two being saws placed side by side, and two supports, which have grooves along their thicker edges, so arranged that the saws glide backwards and forwards, without a possibility of running out of the groove. When the cut is made, the four are drawn together, so as to form a small tube, through which the egg passes, and is carefully deposited in the fissure which has been made in the leaf for its reception. The two pads shown at the sides are covered with sensitive hairs which enable the insect to feel accurately the position for using the saws, and afterwards for depositing the eggs.

22.—*Ichneumon Fly.*

Speaking of ovipositors, we must not forget a numerous family of flies, whose principal characteristic is their method of depositing their eggs. This is the family of *Ichneumonidæ*, or ichneumon flies, one of which you now see on the screen.

There are probably about 3,000 different species of ichneumon flies in Europe alone; and though their manners are extremely diversified, they all agree in the one point, that they deposit their eggs in the bodies of other living insects, generally in those of caterpillars. They all possess very sharp and strong ovipositors, some being very long and capable of piercing wood and similar substances, that they may be able to get at those species of caterpillars that live beneath the bark of trees and in crevices in wood. As soon as the caterpillar feels the point of the sharp ovipositor, he is a doomed insect, for the eggs thus laid in his body are hatched in a few days, and the young larvæ, which resemble minute white maggots, subsist on the vital juices of their victim, but without absolutely destroying it at once; in fact, the insect they infest usually continues to exist for some time, thus affording them a continued supply of nutriment. But when the ichneumon larvæ are ready to enter their pupal stage, they pierce the skin of the dying insect and emerge, each spinning itself up in a small, yellow, silken case, and changing into a chrysalis, from which they will shortly appear as perfect flies, no longer carnivorous, but living solely upon the juices of flowers, and flying about with great agility, in search of suitable insects in which to deposit the eggs from which the next generation will in due course be hatched.

23.—*Indian Firefly.*

Before we leave flies, and pass on to other forms of insect life, we will just glance at an Indian Firefly as representative of that numerous class of luminous flies which are common in India, Central and South America, China, and other parts of the world.

These flies glow at night with a peculiar luminosity, similar to that of our glowworms, except that the light is more intense, and proceeds from the thorax, whereas in the glowworm it proceeds from the abdomen. In all cases the cause appears to be a luminous secretion, Dr. Darwin thought of a phosphoric nature, but this is not admitted by other authorities, and the intensity of the light appears to depend on the insect itself to a great extent, as it waxes and wanes without any apparent outward cause.

When disturbed, the light usually increases, and this is supposed to be caused by the quicker pulsation of the blood. In some districts the fireflies are so numerous as to produce a general illumination, and the natives, we are told, in some parts of South America, have been in the habit of collecting these insects to use as lamps at night.

24.—*Human Flea—Male.*

The common flea is, unfortunately, too well known in every part of the globe for its agility, caution, and the pertinacity with which it feasts on the blood of man, to require much introduction. The specimen on the screen is a male flea of that unpleasant sort that preys on human victims. Nothing can exceed the polished elegance of the shelly armour with which the flea is covered, or the elasticity of its surprising leaps. It has a small head, large eyes, and a roundish body, and two short, hairy antennæ; at a small distance beneath these is the proboscis, which is strong, pointed, tubular, and placed beneath a pair of jointed sheaths. The flea obtains his food by piercing the skin of his victim with two small sharp lancets, which have serrated edges, resembling a saw. These are then worked up and down, tearing the tissues, and enlarging the hole, till the blood can be sucked up sufficiently fast to satisfy the little phlebotomist.

Its suit of sable armour appears to be neatly jointed and beset with a multitude of sharp spines. The joints of its legs are so adapted that it can fold them up one within another, and in leaping they all spring out with great force.

25.—*Human Flea—Female.*

The female flea, a photograph of which is now before us, is considerably larger than the male. The eggs she lays are very small, of an oval shape, and white colour, with a polished surface. They are dropped at distant intervals in any favourable situation. In the space of six days the larvæ are hatched destitute of feet, of a worm-like shape, beset with distant hairs; the head furnished with a pair of short antennæ, and the tail with a pair of slightly curved forks or hooks; they are white in colour, with a reddish tinge, and their motions are quick and tortuous.

In about ten days they attain their full growth of nearly a quarter of an inch long; at this stage they cease to feed, and, casting their skins, they change to an oval-shaped chrysalis, exhibiting the immature limbs of the included insect, which, in summer, emerges in its perfect form in twelve days; in winter the time required for this evolution is considerably more.

It now begins to exert its lively motions, and employs its sharp proboscis in obtaining nourishment from the juices of the first unlucky person to whom it has access.

26.—*Bug.*

It is asserted, though it may be difficult to say how truly, that the bug was scarcely known in England before the year 1670, having been imported from America among the timber used in rebuilding London after the great fire of 1666.

Its blood-sucking properties, and the offensive smell it emits when touched are too well known to require comment.

It is of an oval shape, about the sixth of an inch long, of a flat form, and a reddish brown colour. The female deposits her eggs in the beginning of summer; they are small, white, and of an oval shape, and each is fixed to a small hairlike stalk, which is glutinous, and adheres to anything it touches. During the winter these animals secrete themselves behind walls, old wainscoting, or any neglected places, where they are capable of bearing the most intense frost without injury, and on the return of warm weather again emerge from their concealment. A bug always avoids the light, and takes advantage of every chink and cranny to make a secure lodgment. Its motions are slow and unwieldy, and its sight is so sensitive, that although it persecutes its victim with unremitting assiduity in the dark, the moment it perceives the light, it generally makes good its retreat.

27.—*Sheep-Tick.*

Having noticed some of the human parasites, we will now glance at two or three creatures parasitic on various animals.

The first of these is the sheep-tick, a species of wingless fly; parasitic, as it name implies, on sheep, and only too common in our pasture lambs. It is not strictly an insect, but near enough allied to one for our purpose. The feet are provided with powerful claws to enable the creature to get a good hold while it buries its proboscis in the skin of the sheep, and sucks the blood, which it continues to do till its abdomen becomes round and distended. The result of this operation on the sheep is a large round tumour.

The circular spiracles or breathing apertures can be distinctly seen in the present specimen, at intervals round the edge of the abdomen, which is covered with hairs. The forepart of its body is uncommonly small; the thick rounded abdomen, however, is very large in proportion, the circumference being about the size of a small pea. The colour is pale red, lighter beneath, with an irregular line on each side, and a red spot on the back. It lays only one egg, which is fastened to the wool of the sheep. At first it is white, then brown, and finally the perfect insect escapes from it.

28.—*Parasite of Pig.*

Most animals are troubled with parasites, all of which are so modified in the details of their organs as best to suit the life they lead. Thus, for instance, a dog's flea differs considerably from the species which preys on us unfortunate humans; and a mole's flea again differs from that of the dog. A mole, as is well known, lives entirely underground in perpetual darkness, so that eyes would be useless to it, and to parasites living on it; consequently the mole's flea is blind like the mole itself, the eyes being present only in a rudimentary condition.

The parasite of the pig, which is now before us, bears a great similarity in many respects to that of the sheep, which we have just considered; but it will be noticed that it is slightly modified to suit the animal on which it lives, the hooks or claws being so curved as to lock into the base of the claw when closed.

29.—*Parasite of Flying Fox.*

Just one other parasitic specimen before we leave this class of creatures, and this one chiefly for the purpose of showing the wonderful adaptability of their organs to the work they have to perform.

This parasite which lives on the flying fox is furnished with long legs, terminating, as usual, with hooks for the purpose of maintaining his position on the animal's body, but (probably on account of the wonderful leaps of the flying fox) the lower portions of the legs are, as may be seen in our specimen, a chain of small joints, giving marvellous flexibility and clinging power. In other respects this parasite much resembles those we have already examined.

30.—*Hive Bee's Tongue.*

If we examine the structure of the common bee, the first thing we notice is the proboscis or tongue—the instrument with which the honey is extracted from the flowers. It is not formed like that of other flies—in the shape of a tube, by which the fluid is to be sucked up—but rather like a tongue to lap it up. When thus lapped out of the nectary, it is conveyed to the honey bag.

The tongue is of a conical shape, covered with tiny hairs, and tipped with a curious little tuft. When not in use this delicate organ is enclosed for protection in a double sheath, the halves of which are seen on either side in the present specimen.

31.—*Leg of Bee, showing Pollen Basket.*

While the bee is busy in extracting honey from the flowers, it becomes covered with the pollen of the anthers; this pollen it wipes off with the brushes of its legs, collects every particle, and kneads it into two little masses, which it lodges on the broad surface of the tibia of each hind leg, where some elastic hairs overarch a concavity, and act as a sort of lid.

Thus the bee flies from flower to flower increasing its store of honey, and adding to its stock of kneaded pollen, which is called bee-bread.

32.—*Wing of Bee, showing Hooklets.*

Its wings are provided with a very curious and beautiful adaptation, which greatly increases its powers of flight. If the upper and under wings on each side were to beat the air independently of each other, a certain amount of air would pass between them, and a considerable part of their power would thus be lost. To avoid this the bottom edge of the upper wing is furnished with a series of hooks, which exactly fit a corresponding convolution on the top edge of the under wing. Both of these are well shown in the photograph, now on the screen, and it will be clearly seen how this arrangement entirely gets over the difficulty.

But working bees put their wings to another and a more peculiar use. By means of these marginal hooks they unite each pair of wings into one plane, slightly concave, and form a pair of very ample fans, which in their vibrations describe an arc of 90 degrees. In this way they ventilate the hive.

33.—*Sting of Wasp, showing Barbs.*

The stings of bees and wasps are very similar; they are composed of three parts, the sheath, and two small and penetrating darts, each of which is furnished with several points or barbs, which, rankling in the wound, renders the sting more painful. The sharp-pointed sheath enters first, and this being followed by the barbed darts, venomous fluid is injected.

Sometimes the sting sticks fast in the flesh, and is left behind, but the death of the bee invariably follows.

34.—*Head of Butterfly.*

Butterflies and moths next claim our attention. It is not necessary to show you to-night the forms of these insects in their stages of egg, larva or caterpillar, pupa or chrysalis, and imago or perfect insect, as they are well-known to you, but some of their parts are interesting. We take first the head of the Tortoiseshell Butterfly.

The two long filaments curled up on either side of the mouth form the tongue, and when placed together become a tube, which, when not in use, is kept coiled, somewhat after the fashion of a clock-spring, under the head.

It will be noticed that the antennæ terminate in small knobs, a peculiarity which marks an essential difference between butterflies and moths.

35.—*Antennæ of Moth.*

The antennæ of moths, though very diverse in form, are simply rounded or pointed at the tip, as in the specimen now before us, which shows the antennæ of the Buff Ermine Moth. In this particular instance it will be noticed that the branches or antlers, if we may so call them, of the antennæ are covered with tiny hairs, and a straight thick hair at the end of each helps to make this a most delicate organ of touch, if as many people think that is the object of these peculiar appendages. Others consider them to be organs of hearing or speech ; but all these suggestions are little more than conjectures. Male moths have far finer antennæ than female ; indeed, the latter, unlike human beings, seem to be very careless as to their personal appearance, it being, in their case, the male that indulges in beauty of form and dress to attract the notice of the female.

36.—*Dust from wing of Butterfly.*

You have probably noticed that on touching the wings of a butterfly a quantity of fine dust adheres to the fingers. This dust, when we examine it under the microscope, appears as shown on the screen. Each speck of dust is resolved into a tiny plume, or scale, bearing a strong resemblance to a feather. These scales are attached to the network which forms the wings, by the projecting points, as a feather is attached to a wing by its quill ; and as in the case of birds, it is these plumes which give to the butterflies their varied and beautiful colouring. The scales are arranged upon the wings in transverse lines; the extremities of the scales in one row resting on the bases of those in the succeeding row, like the tiles on the roof of a house. They vary in shape and size on the different species of butterflies, but are all very similar in general form.

And here we must bring our microscopic examination to a close, though not from want of material, for almost every organ of every insect is capable of teaching us something if we care to learn it; and, indeed, on examining these various minute forms to-night, there is one thing which cannot fail to strike us, the fact that there must have been some great and wise power overruling all, to provide such endless adaptability to various environments, as we have found even during our slight glance at the lives of these insects. And the more sciences we study, and the more deeply we dip into them, the more we shall be impressed with the feeling that these arrangements are not due to chance, or a "fortuitous concourse of atoms," as some very credulous persons would have us believe, but that as the poet Thompson affirms,—

"There is a power
Unseen, that rules th' illimitable world,
That guides its motions, from the brightest star
To the least dust of this sin-tainted mould;
While man, who madly deems himself the lord
Of all, is nought but weakness and dependence.
This sacred truth, by sure experience taught,
Thou must have learnt when wandering all alone.
Each bird, each insect, flitting through the sky,
Was more sufficient for itself than thou."

LONDON:
PRINTED BY PERRY, GARDNER AND CO.,
FARRINGDON ROAD, E.C.